DOCUMENT RESUME

ED 470 179 IR 021 621

AUTHOR	Tozoglu, Dogan; Varank, Ilhan
TITLE	Technology Explosion and Its Impact on Education.
PUB DATE	2001-11-00
NOTE	8p.; In: Annual Proceedings of Selected Research and Development [and] Practice Papers Presented at the National Convention of the Association for Educational Communications and Technology (24th, Atlanta, GA, November 8-12, 2001). Volumes 1-2; see IR 021 504.
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	Computer Assisted Instruction; *Computer Attitudes; *Computer Uses in Education; *Educational Technology; Elementary Secondary Education; Higher Education; Instructional Development; *Teacher Attitudes; Teaching Methods; *Technology Integration
IDENTIFIERS	Technology Role

ABSTRACT

Despite the fact that computers, as opposed to other technologies such as television and radio, have significantly impacted education from several perspectives, a consensus about the effectiveness of computer use in education has not been reached among the researchers. The purpose of this paper is to investigate the advantages and disadvantages of using technology in education and to identify the environmental (extrinsic) and personal (intrinsic) factors that cause schoolteachers and university professors to feel unwilling and unenthusiastic toward the notion of implementing technology in the classroom. Discussion includes the effective integration of technology in the classroom; environmental factors of technology integration; teacher training; psychological factors or variables that may determine teachers' use of technology in the classroom; and teacher attitudes towards educational computing. (Contains 37 references.) (Author/AEF)

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Technology Explosion and Its Impact on Education

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ED 470 179

Abstract

We are in the computer age and the federal and local governments have invested significant amount of money to purchase computers for schools. The average computer to student ratio has significantly increased. In the meantime, educational technologists have started questioning the effectiveness of computers in teaching and learning. The purpose of this paper is to investigate advantages and disadvantages of using technology in education and to identify the environmental (extrinsic) and personal (intrinsic) factors that cause schoolteachers and university professors unwillingness and lack of enthusiasm to implement technology in the classroom.

Introduction

Technology has a long history in education. Even though it has been accepted that the first educational technology endeavors started at the end of the 1800s with the school museums, the technology widely started being used after film, radio and television entered in the vision around the 1920s. Public schools modified their programs to some extent, such as rearranging class schedules, to infuse those technological innovations into the school system (Cuban, 1985). However, schools came across several problems including cost of films, insufficient hardware, awkward scheduling of broadcasts and inadequate teacher training. Moreover, the technological innovations at that time did not bring a new educational perspective. For instance, TVs were used as an accessory and substituted by teachers' lectures rather than as an essential instructional tool. Eventually, they disappear from schools very rapidly.

Now we are in the computer age and the federal and local governments have invested significant amount of money to purchase computers for schools. The average computer student ratio significantly increased. In the meantime, educational technologists have started questioning the effectiveness of computers in teaching and learning. The effectiveness of computers is still an issue and a consensus has not been provided among the researchers. However, the computers, as opposed to the other technologies such as TV and radio, have significantly impacted education from several perspectives. It has changed the teachers' role, the school curriculum and the educational research perspective.

The current studies illustrate that the teachers who are successfully employing the computers change their classical roles in the classroom, which are organizing, presenting and evaluating information. They prefer to become a mentor directing and motivating students to create questions, explore and manipulate information, and create solutions for the questions by themselves. They use more student-centered teaching approach and promote self-directed learning. Aligned with this approach, the curriculum has been modified to accommodate more problem-solving activities (Diem, 1996).

The potentials of computers have shifted researchers' attention to cognitive psychology (Shrock, 1995). Psychologists' traditional approach to education, which is measuring changes in students' behavior following educational stimuli, is joined with a concern about the process of cognition. They started considering human learning as the product of a cognitive process working based on cognitive rules and strategies rather than solely stimulus-reinforcement contingency. According to cognitive principles, education is control of cognitive processes in the learner. Learning is more and more being understood as recognition of learner knowledge structures by mapping teacher or expert subject matter knowledge onto the learner's knowledge structure (Popkewitz & Shutkin, 1995).

Advantages of Using Technology

Technology has produced several positive outcomes in education; enhancement of motivation, attitude and enjoyment, new peer interaction patterns and learning performance (Schofield, 1995). The idea that computer use often enhances students' motivation and attitude has been experimented frequently in the recent years. It is supported by many studies that computers are able to enhance student motivation about, interest in and attention to classroom activities.

In a study consisting of 30 fifth grade students in an inner city school, the effect of computer in mathematics, language-arts and social studies were measured. The results showed that the students had more

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positive attitudes towards the educational experience and their attitudes improved during the course of the study in the area of confidence (Kitabchi, 1987). Based on a meta analysis of 199 papers of which 32 were conducted in elementary schools, 43 in high schools, 101 in universities and 24 in adult education centers, it was founded that students liked the classes more and developed more positive attitudes toward computers when they received computer help (Kulik et al, 1987).

Having high attitude, students have more enjoyment, work harder and show more involvement in classroom while working on computers. Why are students motivated and enthusiastic with computers? The literature brings some explanations for this question. The first is that students respond well to computers because they are relatively new in their school experience. The second is that students seem they like working on computers because computers introduce variety into the school routine. Another approach is that knowing how to use a computer would be useful to students in the later life (Schofield, 1995).

Educators have been concerned with interactions among students in a computer-supported instructional environment. Many think that students are isolated from the classroom's social environment when using computers. Yet, studies showed that when students deal with computer related tasks interaction among students increases. As a matter of fact the interaction becomes a learning management tool and students' experiences in-group work may have a direct effect on learning and achievement (Webb, 1989)

Peer interaction has been affected by several factors such as student characteristics, the structure of tasks, and the reward structure (Webb, 1989). Besides those factors, locations of computers, the ratio of students to computers and how teachers chose to handle the educational environment when there are more students than computers determine the pattern of interaction among students. Teachers may control collaboration among students through software. One of the purposes of the education is to teach students necessary skills to prepare them for the job market. Even though there are some objections numerous researchers indicate that the computer is a good means towards that purpose. Many studies proved that students better learn in a computer-supported environment than traditional classroom environment.

Kulik (1994) conducted a meta analysis on more than 500 individual research studies of computer-based instruction. He found that on average, students who used computer based instruction scored at the 64th percentile on the tests of achievement compared to students in the control conditions without computers who scored at the 50th percentile. Also students learned more in less time when they received computer-based instruction. In a similar investigation, 219 research studies on the effect of technologies on learning and achievement across from 1990 to 1997 revealed that students in technology rich environments experienced positive effects on achievement in all major subject areas and showed increased achievement in preschools through higher education for both regular and special needs children (Sivin-Kachala, 1998).

Disadvantages of Using Technology

The technology implementations are not free of risk. Once the technology starts diffusing into schools it comes with unique problems. Some of the important problems are equity and access, time to plan and implement the technology and teachers' resistance to change.

In the technology-based educational change, which could be school-wide, district-wide and statewide, equity and access refers to whether each individual student utilizes computers or the technology at the same level and under the same conditions (Knupfer, 1995). The following variables would explain the obstacles that may cause inequity in the computer access: Geographic region, socioeconomic status, gender, race, various kinds of handicaps, and special learner groups within school. The research indicates that minorities, women, the handicapped and the poor have less access to computers (Anderson, Welch, & Harris, 1984).

Some other factors also may determine the equal access, such as familiarity with hardware and software, the classroom structure, time, students' skill levels and locations of computers. Becker (1985) found that above-average students dominantly use computers. Also, his study revealed that placement of computers within libraries promoted more equal usage of computers between above- and below-average students.

Successful technology adaptation requires a careful planning which demands plenty of time. However, teachers already undergo time shortage with their current tasks (Knupfer, 1995; Hardy, 1998). Time necessary for technology adaptation is not just limited to the planning. Teachers also have to commit some time to learn how to plan the technology integration into curriculum and develop appropriate materials. After all, they will need classroom time to implement the technology. In the current education system, besides other necessary classroom events not enough time is left to carry out instructionally sound and proper computer activities (Dupagne & Krendl, 1992). The literature confirms that teachers who are motivated to use the computer technology in their teaching are more likely to do so if time is provided to develop materials (Hardy, 1998).

Teachers show resistance to educational change in which they should use educational computing. Among several others, two concerns are critical for teachers exhibiting the resistance: Concerns about their machine skills and concerns about taking a risk (Andris, 1996). Teachers are supposed to be competent about computer machine-related skills for classroom and lab activities at least at the elementary level. Though, usually teachers learn those skills through, if possible, school or district supported training and peer tutoring after for a while they do not value their computer machine skills. Although these teachers agree that their machine skills improve over time as they operate computers, they distinguish those skills fromother teaching skills and do not recognize them as relevant to their teaching and they do not think, "operating computers make them a better teacher".

It takes time for teachers to become familiar with computer hardware and software. Because technology vendors continuously upgrade their products and schools always acquire new equipment and computer programs, this is a recurrent problem in schools. Teachers indicate that until becoming accustomed to computers and programs their schools have teaching with them becomes less efficient and less productive than teaching with classical methods. They think using unfamiliar computer materials and methods may risk their consistent level of classroom performance as well as effectiveness of their lessons.

The Effecti ve Integration of Technology

The technology integration in classroom is perceived a complex and challenging procedure by new adaptors. Yet, later, getting more expert on educational technology competencies they see the integration easy and useful (Scrogan, 1989). Computers are promising educational tools facilitating teachers' tasks and improving students' performance. In addition to those, technology plays a central role in educational change (Sudzina, 1993). However, still educators exhibit reluctance to integrate computers into classroom (Dunn & Ridgway, 1991).

Researchers have been investigating the reasons why educators at all levels, schoolteachers and university professors; show unwillingness and lack of enthusiasm about the technology. Several causes have been discussed. However, it is very hard to put those reasons into an accurate categorization because they are not clearly separated from each other. Besides their effects on inadequate computer integration, they interact with each other, as well. However a categorization of the factors would be as follow: Environmental (extrinsic) factors and personal (intrinsic) factors (Dusic, 1998; Ertment, 1999). Intrinsic factors are the ones caused by the setting or situation in which the technology is implemented. Extrinsic factors are coming from teachers' personalities and understanding of technology integration.

Environmental factors

Providing adequate hardware and software is an important factor in promoting technology integration (Zammit, 1992). If computers are not available during convenient times and/or software is unavailable in sufficient quantities or at an adequate level of quality one should not expect high levels of usage regardless of the level of interest (Stieglitz & Costa, 1988). Schoolteachers and university professors indicate that the quality and quantity of hardware and software is insufficient (Hoffman, 1998). Schools and departments need more computers and computer peripherals, such as scanners and data projectors. The ones having computers and peripherals should continuously upgrade them due to the rapid change in technology. Software is not satisfying the educators' need. Teachers generally evaluate software as being pedagogically weak or inappropriate and think it is not worth the effort to use it (Zammit, 1992). What is generally needed is well designed, adaptable, user-friendly and uncomplicated computer programs. (Hardy, 1998; Downes, 1993; Ritchie, 1996; Cafolla & Knee, 1995; Sheingold & Hadley, 1990; Dunn & Ridgway, 1991)

Support also plays an important role in technology diffusion in education. The support may be in three different forms: Technical support, pedagogical support and management support. Technical support is important because teachers and faculties always need help with the equipment in classrooms. Most of the time, they are not able to overcome technical problems occurring during instructions and need to call a support person (Dusic, 1998; Hardy, 1998).

Pedagogical support is related to technology planning, development, implementation and teacher consulting. Pedagogical support should be provided by technology coordinators (Zammit, 1992). Technology coordinators are supposed to inform teachers of how to use certain equipment. Equipment use is not necessarily only limited to physical use but related to how that piece of technology is integrated into instruction, how to plan for its use, and how to improve students learning performance and motivation. Also, technology coordinators should enlighten teachers with concurrent educational technology innovations and learning theories/models (Ritchie, 1996). Hoffman (1998) claims that the pedagogical support provided by the coordinators leads to greater use of software

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that promotes higher order thinking skills, and greater use of computers as tools in academic activities rather than as mere drill-and-practice.

School boards, districts and school management are not providing adequate administrative support for technology infusion (Cafolla & Knee, 1995). Administrators from different management levels are key people making strategic and executive decisions within schools or school systems and universities. With those decisions, administrators may provide teachers with directions about educational technology use, involve teachers in the technology adaptation process, provide necessary hardware and software, provide incentives that can encourage and motivate teachers to start and continue integrating technology into their lessons (Hoffman, 1998; Knupper, 1989; Dupagne & Krendl, 1992). One solution to overcome this problem and widespread the technology in schools is to train administrators on educational technology and make them comfortable computer users so that their attitude towards technology is improved and they provide more help teachers to integrate technology in their lessons (Ritchie, 1996). The following factors are also considered related to teachers' educational computer use: Risk of using technology, sharing of technology resources between teachers (Dusic, 1998), discouraging climate to use computer within schools, lack of use of computers for personal purposes and not having a computer at home (Downes,1993).

Teacher training

To this point, several environmental factors, such as lack of hardware and software, pedagogical and technical support, management support and so forth, have been discussed. Teacher training also occupies an important place as an environmental obstacle (Hardy, 1998; Dusic, 1998). Significant number of teachers had very little in-service training about educational technology (Zummit, 1992). This might be the reason that one of the major concerns teachers and faculties carry is "hows" of using technology in the classroom (Dupagne & Krendl, 1992). Instructional computer applications require new competencies and knowledge. Not having those competencies and knowledge, teachers should not be expected to adopt technology in the classroom (Marcinkiewicz, 1995). Successfully technology-using teachers indicate that they learned their technology skills thorough formal and non-formal training; such as workshops, courses at local colleges, in-service training offered by their districts, in-service training at their school site and non-in-service courses offered by districts (Hoffman, 1998).

Even though teachers have positive attitudes towards technology and want to improve their teaching performance through technology implementations they are not able to accomplish it. They are not having knowledge to use the machine, and not having any kind of familiarity or expertise with computer based or computer managed instruction (Onika, 1992). The reason is that experienced teachers have not had appropriate training on how to effectively use the computer in the classroom and on technology, skills, ideas and ways to integrate instructional technology into the curriculum (Dunn & Ridgway, 1991). In addition to this, new teachers have very limited knowledge about educational computer use. Teacher students do not have adequate exposure to instructional technology because many educational institutions and faculties within those institutions have not adopted technology. Whereas, the more teachers have exposure to and experience with computers the better they integrate computers into their teaching. (Hardy, 1998)

Comprehensive staff technology teacher development models and programs are needed. Those programs should provide clear directions for teachers on integrating technology in classroom and help them construct the purpose and meaning of educational technology (Hardy, 1998). The training should be designed in a way so that it contributes to teachers' continuous development. Therefore, new adopters or new teachers should be encouraged to try out their developing IT skills early in their carriers, and not wait until their theoretical knowledge is highly developed (Dunn & Ridgway, 1991).

Personal Factors

Besides environmental factors as explained above, some psychological factors or variables, such as confidence, fear, will and motivation, may determine teachers' use of technology in classroom. Hardy (1998) indicates that around 40-50 percent of teachers avoid using computers because they lacked confidence, felt uncomfortable, and were frightened, threatened and intimidated by computers. Sometimes teachers' or faculties' belief about technology and education may determine their behavior towards technology use. They think computers are complicated machines to use and master. Also, some think it is a temporary movement within current schooling system rather than a useful trend. Teachers' traditional belief and experience with schooling inhibits them from taking instructional risks and implementing technological innovations in the classroom (Sudzina, 1993).

The literature concentrates on three major personal variables or factors: Anxiety about technology, teachers' or faculties' personalities and attitudes towards the technology integration. The major indicator of computer anxiety is avoiding from or interacting with computers (Dusic, 1998). Hardy (1998) indicates in a study investigating computer aversion it was found that teachers are very hesitant about computer related tasks, which includes using computer machine and related peripherals in teaching, helping fellow teachers when they have trouble with computers and applying to a job requiring an initial computer training. Some reasons are brought for computer anxiety, such as inadequate planning and applications of technology-based educational change and ineffective communication between instructors and administrators (George, 1996). Jordan (1993) adds the following three reasons: "Teachers, trained to master the traditional tools and materials of their profession, fear their lack of expertise with computers will be embarrassing and undermine their classroom authority, some teachers may be uncomfortable with the ways that classroom roles and relationships between teacher and student change when computers are introduced into the classroom, teacher productivity and student success can be monitored with computers easily, but many teachers worry about accountability since the problem solving skills they try to teach may not be measurable through assessment instruments they have been using". Improving self-efficacy would be a useful method to decrease teachers' anxiety. Self-efficacy is achieved through helping teachers use computers effectively, having them observe other successful users, mentoring teachers on the educational technology and creating anxiety-free environments or situations (Dusic, 1998).

Psychologists classify people according to their personalities. Some empirical research data shows that there are connections between educators' types of personalities and use of educational technology. Smith et al. (1995) attributes the features of being creative, analytical, logical and imaginative to institutive/thinking types of educators and says they are more open to educational technology than sensory types of people who are practical, realistic and sociable. On the other hand, comparing the other personality traits, sensory/feeling types of people show very reluctant behavior towards adapting technology in the classroom. In a similar study, the personality types were classified as follow: extraversion/introversion, sensing/intuition, thinking/feeling, judging/perceptive and it was found that those personality variables may determine the amount of technology training taken, perceived adequacy of the training, perceived support from management and perceived factors or barriers to adapt computers in curriculum (Knupper, 1989).

Teacher attitude

Teacher attitude is the most commonly used term in the literature to describe practitioners' appealing to educational computing. For instance some teachers perceived that computers did not provide a distinct advantages over traditional methods of teaching (McCormak, 1995) some others value them as a useful tool to support meaningful learning. Attitude is defined as evaluative disposition based on cognition, effective reactions and behavior intentions and determines future behavior as using the computer as a professional tool and integrating technology in the classroom (Dusic, 1998). As can be seen from the definition it covers a very broad meaning. Due to that it is used interchangeably with motivation and anxiety. As a matter of fact, attitude scales are created based on other psychological states. For instance, Loyd (1985) created a computer attitude scales derived from computer anxiety, computer confidence, computer liking and computer usefulness. Computer anxiety is related to fear of computer, computer confidence is about self-reliance to learn and use computers, computer liking is enjoyment from working with computers and computer usefulness is related to perceived effectiveness of computer.

Significant attitudinal difference towards educational computing is found between teachers who are technology users and those who are non-users (Galowich, 1999). The more teachers are willing to use computers in the classroom, the more their attitudes are favorable toward computers (Dupagne & Krendl, 1992). In addition to that, the teacher attitude is significantly related to computer literacy knowledge. Also, it is expected that there is a connection between using computer outside of work and the attitude (Galowich, 1999). Attitude is not a clear-cut measure to indicate teachers' disposition towards technology, such as high/good attitude and low/bad attitude. Teachers having different experiences, varieties of supports and different incentives and barriers may exhibit different attitudes.

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